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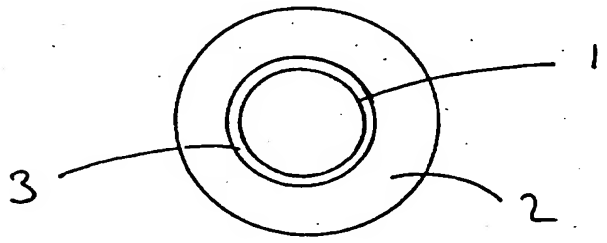
(54) Title: PIPE COATING

(57) Abstract

A pipe coating comprising an anti-corrosion coating having a film thickness typically of from about 350 μm to about 500 μm, and a protective weight coating (2) of a urethane based copolymer applied over said anti-corrosion coating, said protective weight coating (2) incorporating a high density filler material.



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PIPE COATING

This invention is concerned with coating of pipes of the type used in subterranean or submerged pipelines for recovery of oil, gas, slurries or the like pipeline materials from a subterranean well. In particular it is concerned with pipes in which a steel pipe section is coated with an anti-corrosion coating and then an anti-buoyancy coating.

Underwater pipelines are most frequently used for transporting hydrocarbons from the off-shore reservoirs to shore. With such substances, it is important that the temperature within the pipeline does not fall below a certain level, otherwise hydrate and wax formation and deposition occur. The temperature of the hydrocarbons increases with the depth of the reservoirs. In the transportation of such materials it is necessary to prevent heat loss from the hydrocarbons and this is generally addressed by providing an insulating coating around the pipeline.

Underwater pipelines may also require a weight coating for several purposes including the need to weigh the pipeline down and so maintain the position of the pipe on the seabed and to form a protective cover around the pipeline.

Concrete coatings have in the past served this purpose. However, concrete has poor insulating properties and is therefore not ideal for this application. Furthermore, set concrete is inflexible and therefore prone to cracks or damage both during the pipe-laying process and afterwards when the pipeline is in position on the sea bed. Such damage can lead to the concrete coating falling off the pipeline and loss of the insulation for the pipeline.

British Patent No. 1 573 814 discloses a coating for a pipeline comprising a weight coating of an elastic material,

for example rubber containing iron powder and ore if desired. Rubber is an expensive material and in addition has poor insulating properties.

West German Patent No. 2 544 194 discloses a flexible pipeline where an inner pipe of synthetic rubber is coated with several layers of rubber, having steel bars incorporated therein. This coating does not insulate the pipe, the function of the synthetic resin being merely to pack the open structure of the steel bars.

Considering the objective of insulation, it has been proposed to use polyurethanes as a bilayer syntactic urethane system and a typical weight coating of concrete is applied thereafter as required.

Another known type of insulation comprises layers of rubber and PVC-foam. Preformed blocks of PVC or a PVC bandage are placed around the pipe and then rubber bandages are wrapped around the blocks, so securing the PVC. The rubber coating must then be vulcanised before the pipe can be used. This method gives pipes of good quality, but they are expensive to produce. The pipes also have reduced application because of the thermal resistance of the PVC-foam (about 50-80°C).

The present invention aims to overcome the above problems associated with known pipe coatings and to provide an improved pipe coating which displays both good insulating properties and gives weight to the pipeline, which can be reeled from a dynamically positioned vehicle and which is, at the same time, easy to apply, flexible, and easy to work with.

According to one aspect of the present invention there is provided a pipe having an anti-corrosion coating typically having a film thickness of from about 350 μm to about 500 μm, and a protective weight coating of a urethane based copolymer applied over said anti-corrosion coating, said protective weight coating incorporating a high density filler material.

Preferably, the high density filler material is an inorganic particulate material such as micro fine barium sulphate.

Advantageously, a slot is provided in the surface of the protective weight coating for laying an induction cable, the slot preferably being frustoconical in section, the width of the slot increasing away from the surface of the protective weight coating.

Preferably, three slots are provided in the surface of the protective weight coating, the slots being equispaced around the circumference of the coating.

Advantageously, the protective weight coating has a depth of between 60 to 80 mm.

Preferably, the anti-corrosion coating is an epoxy resin.

One embodiment of the present invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a schematic cross-sectional view of a pipe coated with a coating according to one aspect of the present invention;

Figure 2 is a schematic cross-sectional view of the pipe of Figure 1 provided with a slot for carrying an induction cable; and

Figure 3 is a schematic view of an apparatus for inserting the induction cable into the slot of Figure 2.

Turning to the Figures, Figure 1 shows a schematic cross-sectional view of a pipe 1 having a protective weight coating 2 applied thereto according to one aspect of the present invention. The pipe is first provided with a fusion bonded anti-corrosion epoxy coating 3 of a thickness of up to about 500 μm (microns) onto which the protective weight coating is applied through a molding process.

The protective weight coating 2 comprises a compound containing a urethane plastics material and a high density filler material. The preferred filler is micro fine particulate barium sulphate which is dosed into the urethane during the molding process. The weight coating may be applied onto the pipe up to any thickness as required but is generally of the order of 60 to 80 mm. The coating is provided along substantially the whole length of the pipe, ending adjacent the ends of the pipe in order to allow successive pipes to be joined together in a process to be described further below.

A longitudinal slot 4 is cut into the coating to allow for the insertion of a heat induction cable 5 at the time of laying the pipeline. The slot is frustoconical in cross-section as shown in Figure 2, with the width of the slot increasing radially inwards from the surface of the coating. The width of the opening 6 of the slot 4 in the surface of the coating 2 is just less than the diameter of the cable 5 to be inserted as will be described below. The depth of the slot 4 is generally half the depth of the coating.

In the preferred embodiment of the invention, three such slots 4 are provided in the coating, the slots being equispaced around the surface of the coating.

The process of laying a pipeline will now be briefly described. A plurality of pre-manufacture pipe sections, each of which is provided with a coating as described above, are loaded onto a pipe-laying barge of a known type and transported to the area where the pipeline is to be laid.

The pipe sections are laid end to end on conveyors on the barge and carried to a coupling station. Referring to Figure 3 there is shown a schematic view of a roller 7 carried on the barge for laying the pipeline, the roller being adapted to move across the surface of the pipeline sections to press the induction cable 5 into the

longitudinal slot 4. As shown in Figure 2, the cable 5 is oversized for the outer width 6 of the slot so that once the cable is inserted by a "snap-fit" into the slot it is securely retained therein. Due to the configuration of the slots, water can circulate around the induction cables thereby allowing preventing any localised scorching of the protective weight coating. Furthermore, the cables are easy to replace in the event of damage or failure of the cable.

During transfer of the pipe sections along the conveyors, the free ends of adjacent pipe sections may be welded together in one or more welding operations prior to the following bonding process.

The ends of two adjacent pipes are encapsulated in a jacket and a urethane is pumped into the jacket between the ends of the pipes. The urethane is a fast acting plastics material which will cure quickly and undergo a chemical reaction with the urethane in the weight and insulating coating to chemically bond the connecting section to the general coating. This gives the pipeline 100% integrity along its length.

The pipe line is then played out from the end of the barge and lowered onto the sea bed. Due to the flexibility of the weight and insulating coating described above, the pipeline can withstand the tensile stress placed on it during the laying process and the pipeline does not suffer damage during this process.

Such a weight and insulating coating 2 formed of the above materials has been found to provide in the region of five times the insulating effect of concrete.

Due to the non-carbon and non-magnetic properties of the weight and insulating coating 2 described above, heat is not drawn from the induction heating system as has previously been the case with concrete coatings where heat

was lost from the induction system to heat the steel cages around the pipeline. Therefore, the induction system for the pipeline works more efficiently with the above described coating than with previously used concrete insulating coatings.

Furthermore, due to the absence of voids in the above described system, it is anticipated that zero creep will occur during the life of the pipeline due to pressure of the water surrounding the pipeline.

It is envisaged that the coating described above will be used on pipelines laid to a depth of approx 1500 m and in temperatures between 0°C and 100°C. These figures should not, however, be taken as limits for the use of the coating.

CLAIMS

1. A pipe coating comprising an anti-corrosion coating having a film thickness typically of from about 350 μm to about 500 μm, and a protective weight coating of a urethane based copolymer applied over said anti-corrosion coating, said protective weight coating incorporating a high density filler material.

2. A pipe coating according to claim 1, wherein the high density filler material is micro fine particulate barium sulphate.

3. A pipe coating according to claim 1 or 2, wherein a slot is provided in the surface of the protective weight coating for laying an induction cable.

4. A pipe coating according to claim 3, wherein the slot is frustoconical in section.

5. A pipe coating according to claim 4, wherein the width of the slot increases away from the surface of the protective weight coating.

6. A pipe coating according to any one of claims 3 to 5, wherein three slots are provided in the surface of the protective weight coating, the slots being equispaced around the circumference of the coating.

7. A pipe coating according to any one of the preceding claims, wherein the protective weight coating has a depth of between 60 to 80 mm.

8. A pipe coating according to any one of the preceding claims, wherein the anti-corrosion coating is an epoxy resin.

9. A pipe coating substantially as hereinbefore described with reference to and as shown in Figures 1 and 2 of the accompanying drawings.

10. A pipe suitable for subsea use coated with an anti-corrosion coating and an outer substantially void-free polyurethane coating incorporating an inorganic filler material.

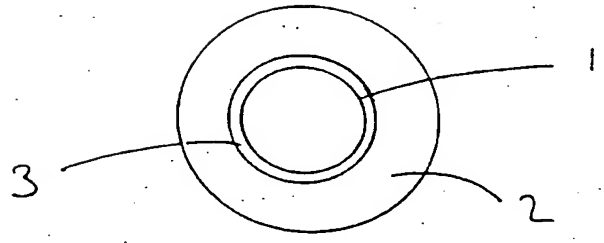

Figure 1

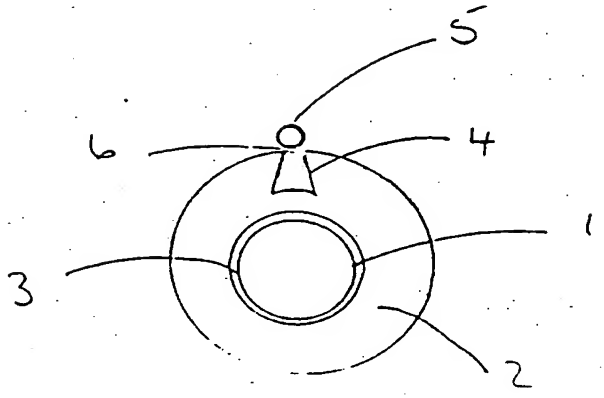

Figure 2

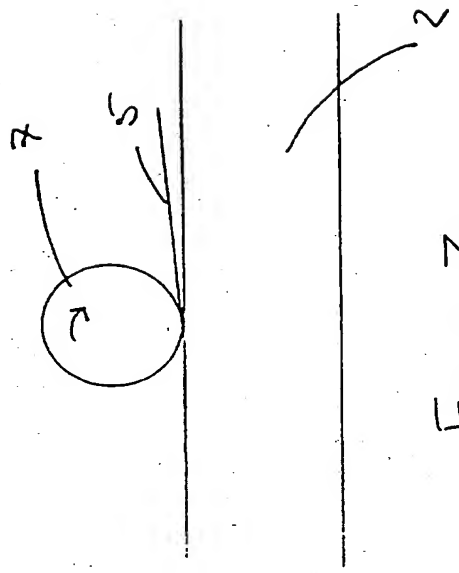

Figure 3

INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/GB 96/00559

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 F16L53/00 F16L58/10 F16L59/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 F16L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP,A,0 112 706 (WEBCO INDUSTRIAL RUBBER LTD) 4 July 1984 see abstract; figures 1,2	1,3,10
Y	GB,A,1 181 672 (THE BAXENDEN CHEMICAL COMPANY LTD) 18 February 1970 see page 2, line 37-70	1,10
Y	WO,A,90 05266 (DEN NORSKE STATS OLJESELSKAP A.S.) 17 May 1990 see page 9, line 1-8; figure 3	3
A	GB,A,2 197 705 (AKER ENGINEERING A/S) 25 May 1988 see abstract; figures 1-3	1

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
21 June 1996	12.07.96

Name and mailing address of the ISA	Authorized officer
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP,A,0 132 219 (MANNESMANN AG) 23 January 1985 see page 6, line 24 - page 7, line 13; figure 1 -----	1,8

2

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INTERNATIONAL SEARCH REPORT

information on patent family members

Inte onal Application No
PCT/GB 96/00559

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GB-A-1181672	18-02-70	NONE		
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		EP-A-	0441814	21-08-91
		NO-C-	174068	23-05-95
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